Securing Mobile and Wireless Networks

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Outline

- Network Security, What is it?
- Security Truths
- Mobile and Wireless Networks
- Issues / Challenges
- USCG/NASA/Cisco Neah Bay Project
- Military Scenarios
- Conclusions

Network Security – What is it?

- !!! Policy !!!
- Encryption
- AAA (Authentication, Authorization and Accounting)
- Architecture
- Confidentiality
- Prevention, Detection and Correction

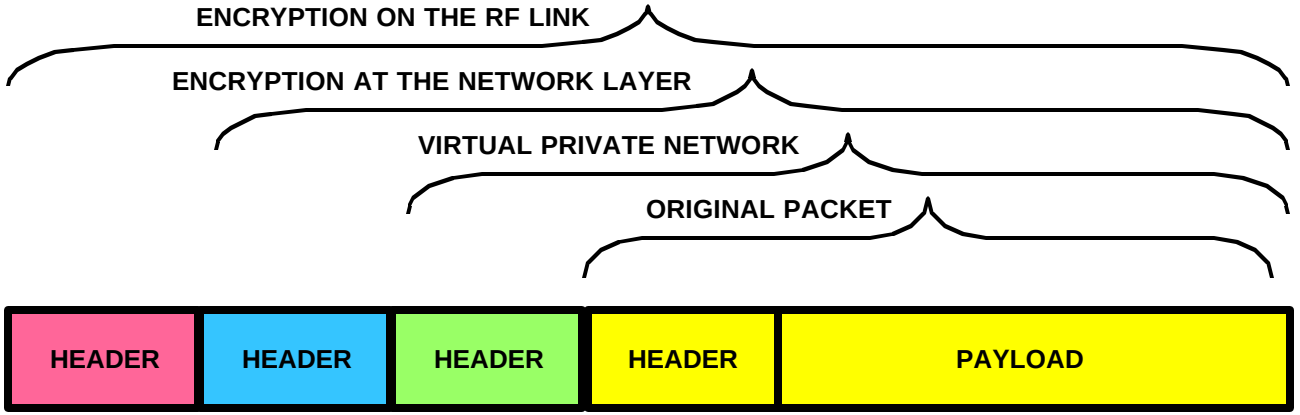
Security Truths

1. Security is necessary
2. Security is painful
   - At least to date it is
3. Security breaks everything
   - Well, enough things so that it appears to break everything
   - Lots of ingenuity required to make things work

New IETF End-to-End concept/reality is application-to-application rather than to machine-to-machine → due to middleware.

Security Truths

- Security ↑ Bandwidth Utilization ↓
- Security ↑ Performance ↓
- Tunnels Tunnels Tunnels and more Tunnels
- Performance ↓ Security ↓
  ⇒ User turns OFF Security to make system usable!
- Thus, we need more bandwidth to ensure security.



Mobile and Wireless Networks

What Do We Mean?

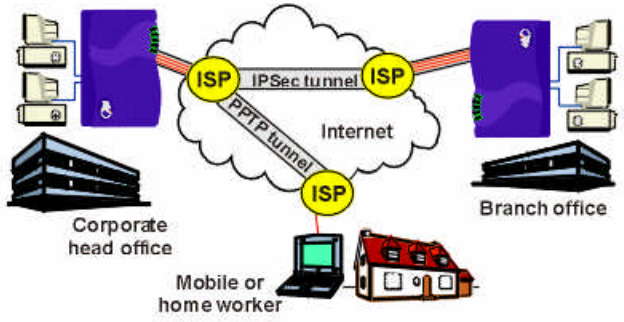
Entire Networks in Motion - Mobile Router (One View)

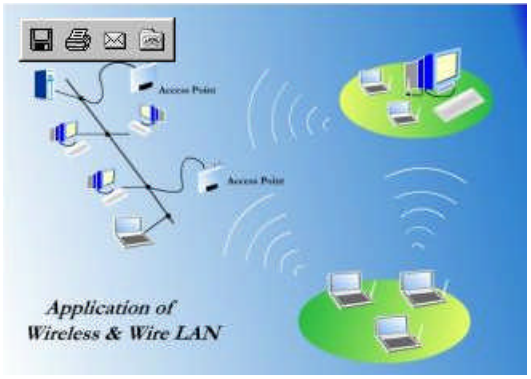
Mobile Network (Another View)

- Mobile users rather than mobile networks
- VPNs
- Dial-In
- Wireless LANs
- DHCP

⇒ This is what the corporate user of the airborne Internet "sees" as mobility

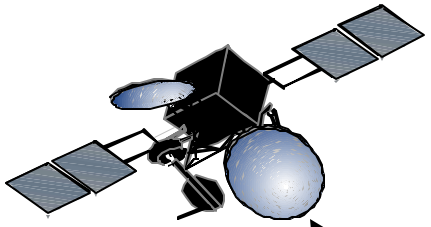
⇒ This is the cabin environment

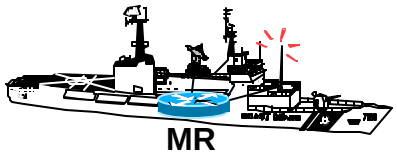




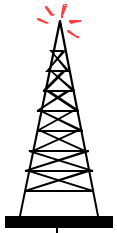
Issues and Challenges

Shared Infrastructure





Canadian Coast Guard



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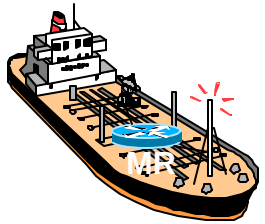
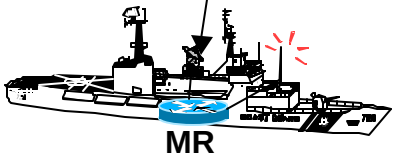


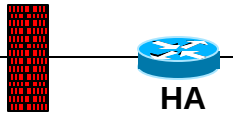
ACME Shipping

FA

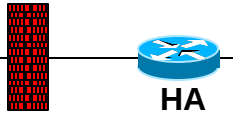


US Coast Guard

Public Internet



HA



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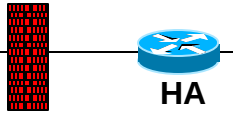

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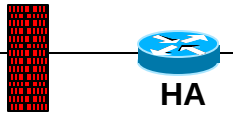


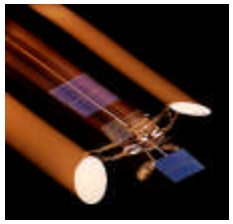
HA

ACME SHIPPING

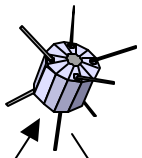
US Navy

If I run encryption on the wireless links, it will be very difficult to share infrastructure – Policy and Architecture

Asymmetrical Pathing



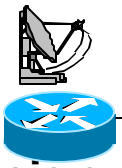
DVB Satellite



MilStar, Globalstar, Others

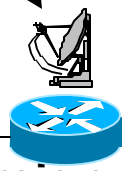
Bi-directional links are often assumed. Unidirectional links can be problematic for encryption and AAA.

Mobile Router



Foreign Agent

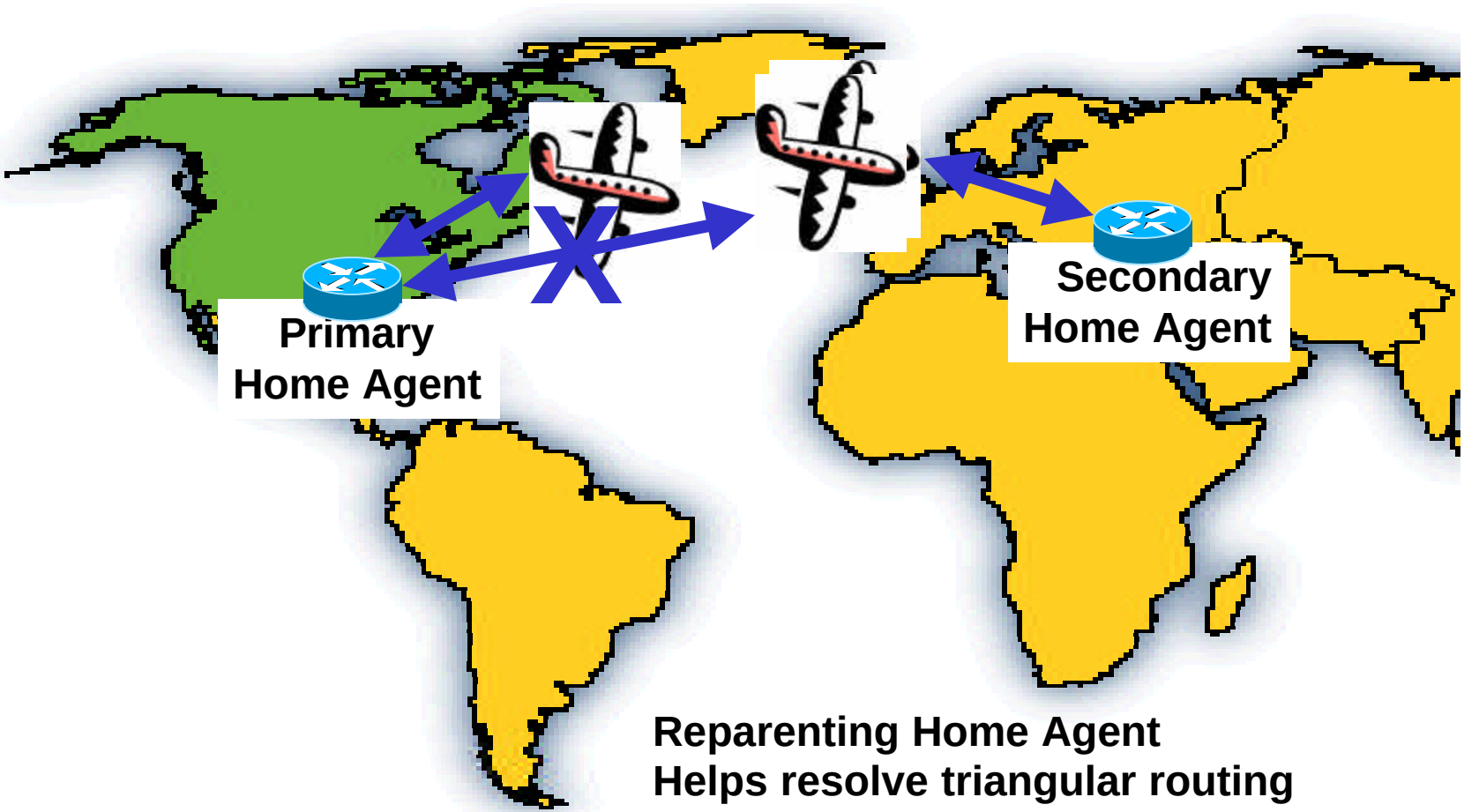
Internet



Foreign Agent

Home Agent

Reparenting the HA in Mobile-IP



Reparenting Home Agent
Helps resolve triangular routing
Problem over long distances

Encryption associations break
when handing off between networks ☹

Key Distribution

- Painful
- Difficult
- Needs to be worked to be more manageable and scalable
- Problem grows as network grows
- Sharing infrastructure makes the problem more difficult
- Military key distribution is even worse

Fortunately, this problems is being addressed by industry ☺

Middleware

- Firewalls
- Network Address Translators (NATs)
- Performance Enhancing Proxies
- Load Sharing Devices
- Traffic Shapers
- Web Accelerators
- Transparent Proxies
- Normalizers

Middleware

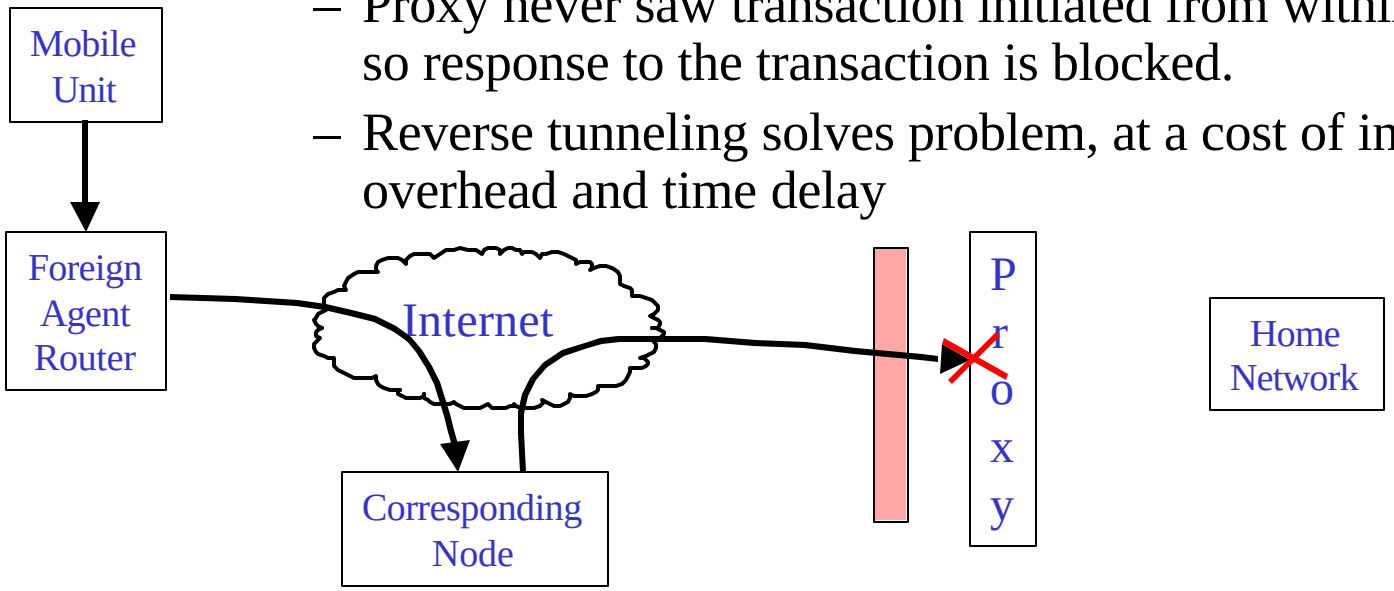
- Middleware is a reality and it doesn't appear to be going away. Rather its use is increasing – particularly with regard to network security
- This patchwork of "goop" we're putting in the network may be degrading the performance of the network.
- It is defiantly degrading our ability to figure out what is wrong with the network.
- We need to consider how the architecture should be changed to meet some of the challenges the network faces today that were not issues when the original vision was developed.
  - Deep thinking on architectural principles for the new millennium.

Example #1

- GRC personnel ran what appeared to be a complete successful transaction from inside the GRC firewall to a machine at BBN that was outside the GRC firewall.
  - Problem was that the BBN machine had been turned off for six months!
  - GRC proxy spoofed the transaction.
    - So you thought you sold you ENRON shares before it tanked, but you were wrong – only, you didn't know it until it was to late.
    - Or, you thought you sent a successful command to the aircraft, but you were wrong ☹
  - The Network Researchers say something is wrong, it is broken.
  - The Security Implementers say that is the way it is suppose to work.

Example #2

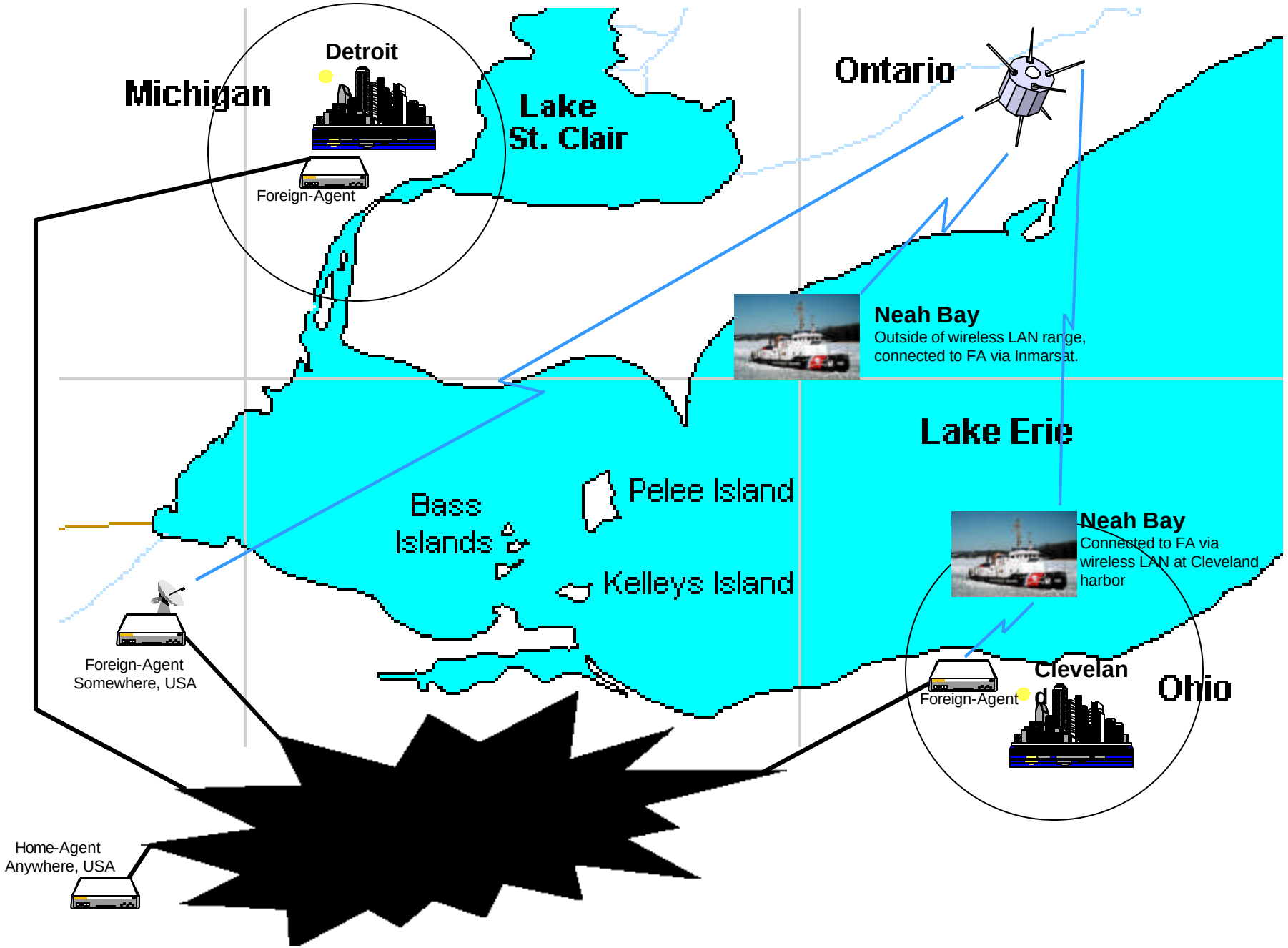
- Mobile-IP using IPv4
  - GRC firewall blocks UDP traffic
    - Need to open UDP port 436
      - Security Issue (Policy)
  - Triangular routing squashed at GRC proxy/NAT
    - Responses to transactions that originated outside the firewall are blocked by the proxy/NAT which is holding state.
      - Proxy never saw transaction initiated from within GRC network, so response to the transaction is blocked.
      - Reverse tunneling solves problem, at a cost of increased overhead and time delay



Middleware and Encryption

- Encryption renders most (if not all) Performance Enhancing Proxies (PEPs) useless relative to the encrypted flow.
- Many types of encryption make QoS engineering problematic
  - Protocol header bits hidden (IP in IP)
  - TOS header bits may be hidden

Neah Bay / Mobile Router Project

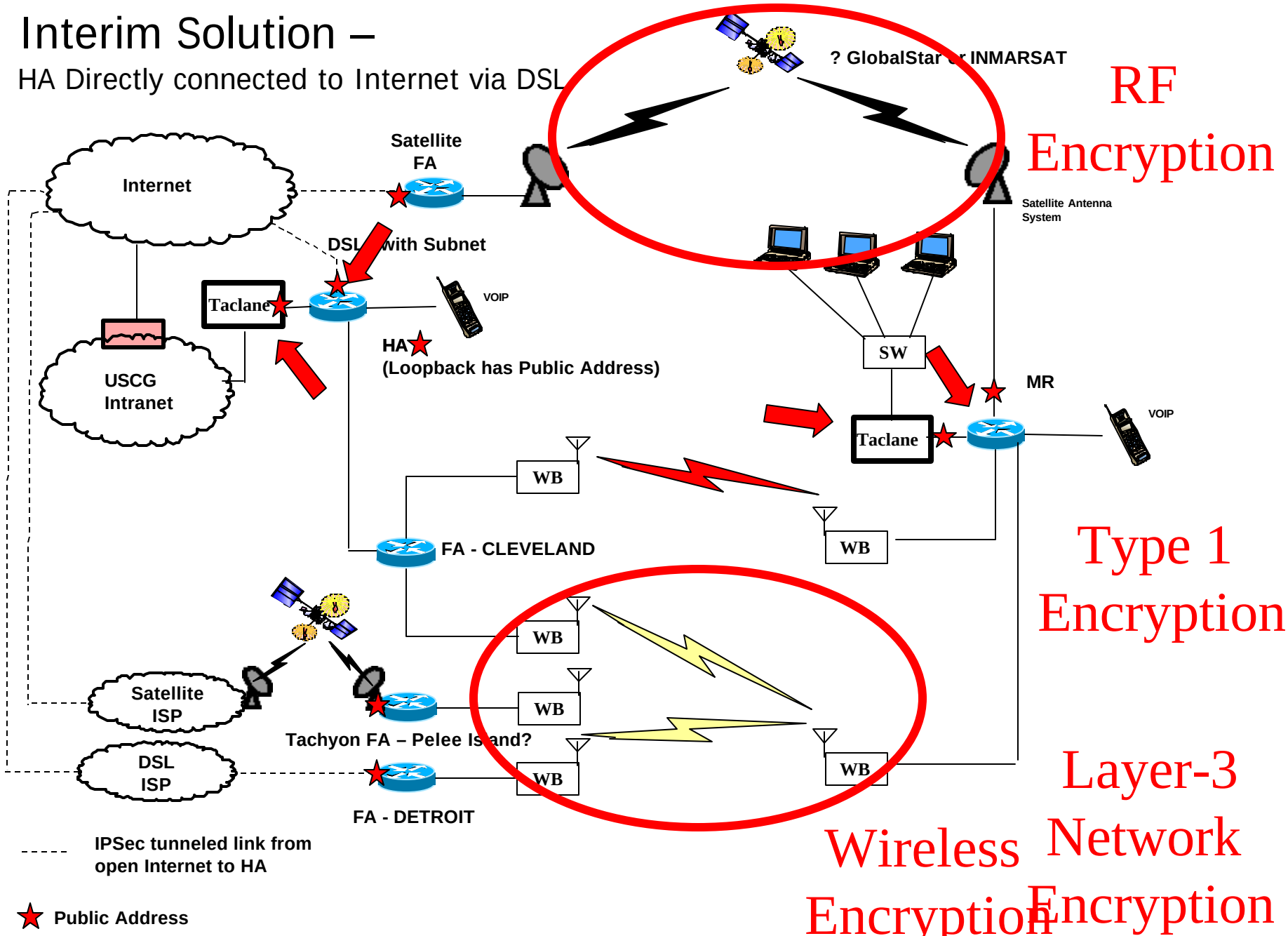


Security Issues Being Addressed

- Shared Infrastructure
- Wireless LAN Security
  - Advancements to WEP
- Mixed Address Space
  - NATs and Proxies
- Low Rate Links
- Satellite Links
- Performance over multiple tunnels
- Manageable and Scaleable Architecture

Interim Solution –

HA Directly connected to Internet via DSL

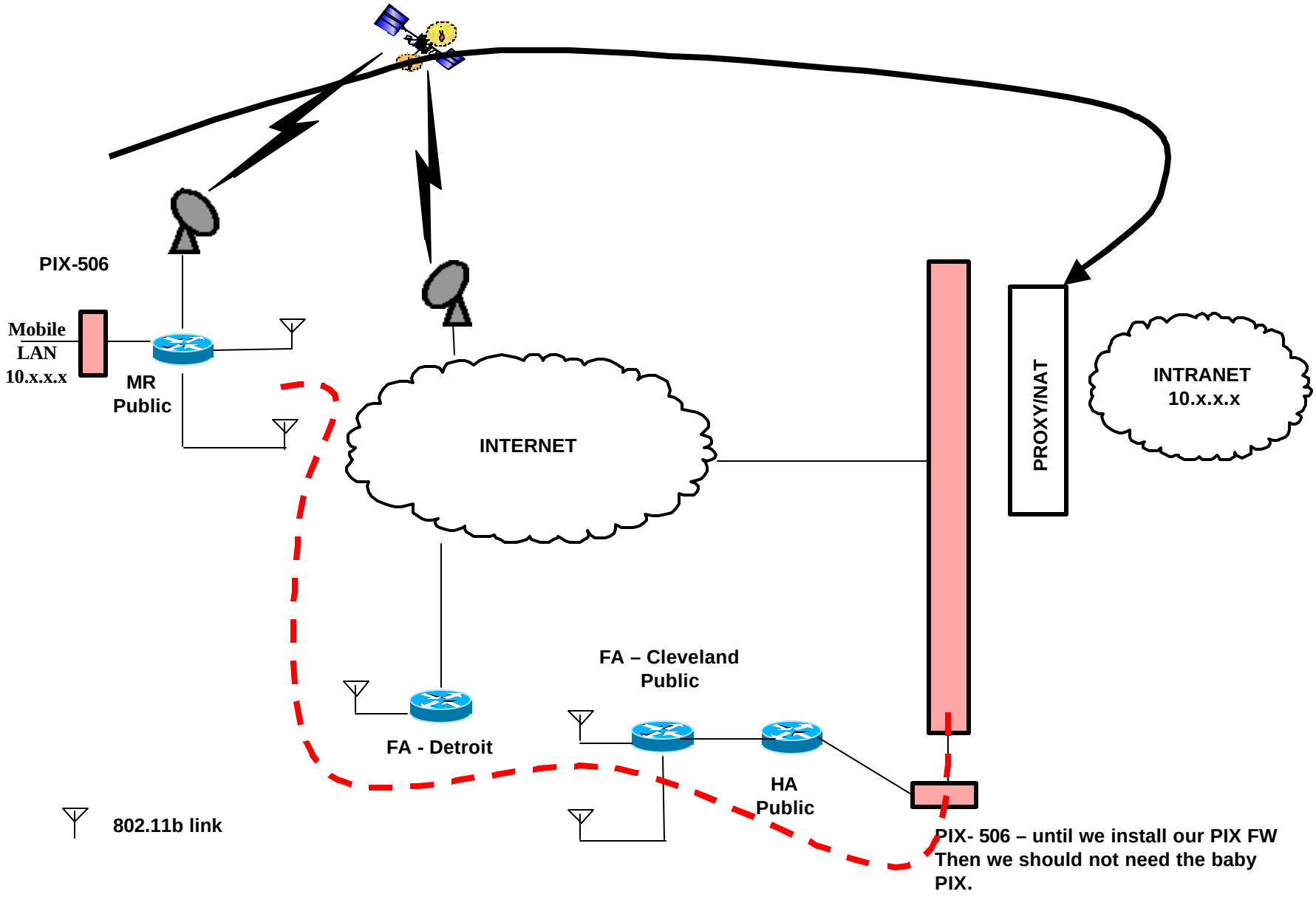


RF Encryption

Type 1 Encryption

Layer-3 Network Encryption

Wireless Encryption

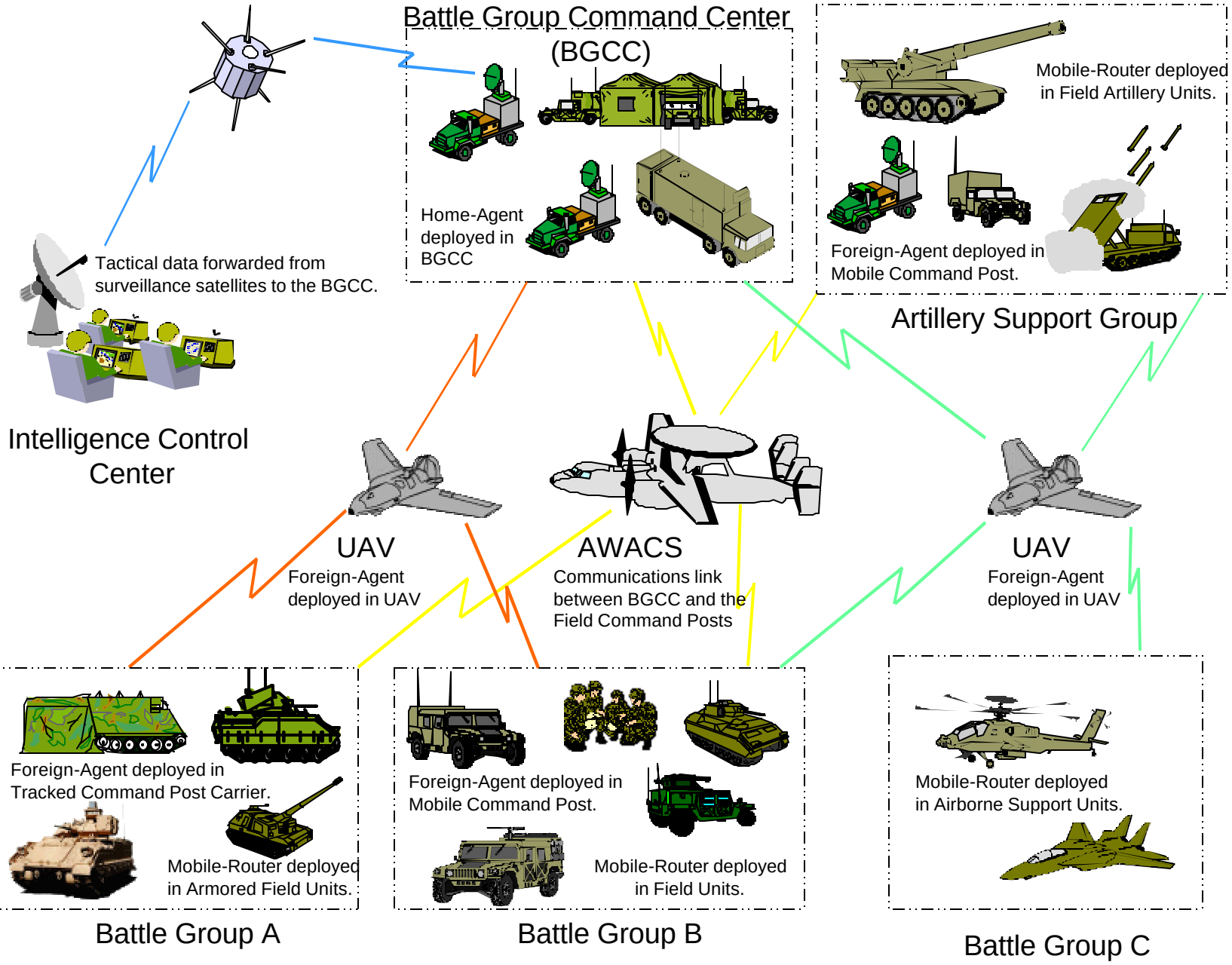

PIX-506
Mobile
LAN
10.x.x.x
MR
Public
INTERNET
PROXY/NAT
INTRANET
10.x.x.x
FA – Cleveland
Public
FA - Detroit
HA
Public
802.11b link
PIX- 506 – until we install our PIX FW
Then we should not need the baby
PIX.

Protect the MR LAN

- Firewall between MR LAN and MR as well as HA and Private Intranet
- Tunnels necessary between FAs on Internet and Firewall to provide connection of private address space over public Internet.
- Reverse tunneling required as requests from MR LAN hosts must pass through Proxy inside main firewall.

HA Outside/Collocated with Main Firewall

- Firewall between MR interfaces and public Internet as well as FA interfaces connecting to the private Intranet and the HA and Private Intranet.
- Multiple VPNs required. One for each possible interface combination.
- Tunnels necessary between FAs on Internet and Firewall to provide connection of private address space over public Internet.
- Reverse tunneling required as requests from MR LAN hosts must pass through Proxy inside main firewall. VPNs take care of this.



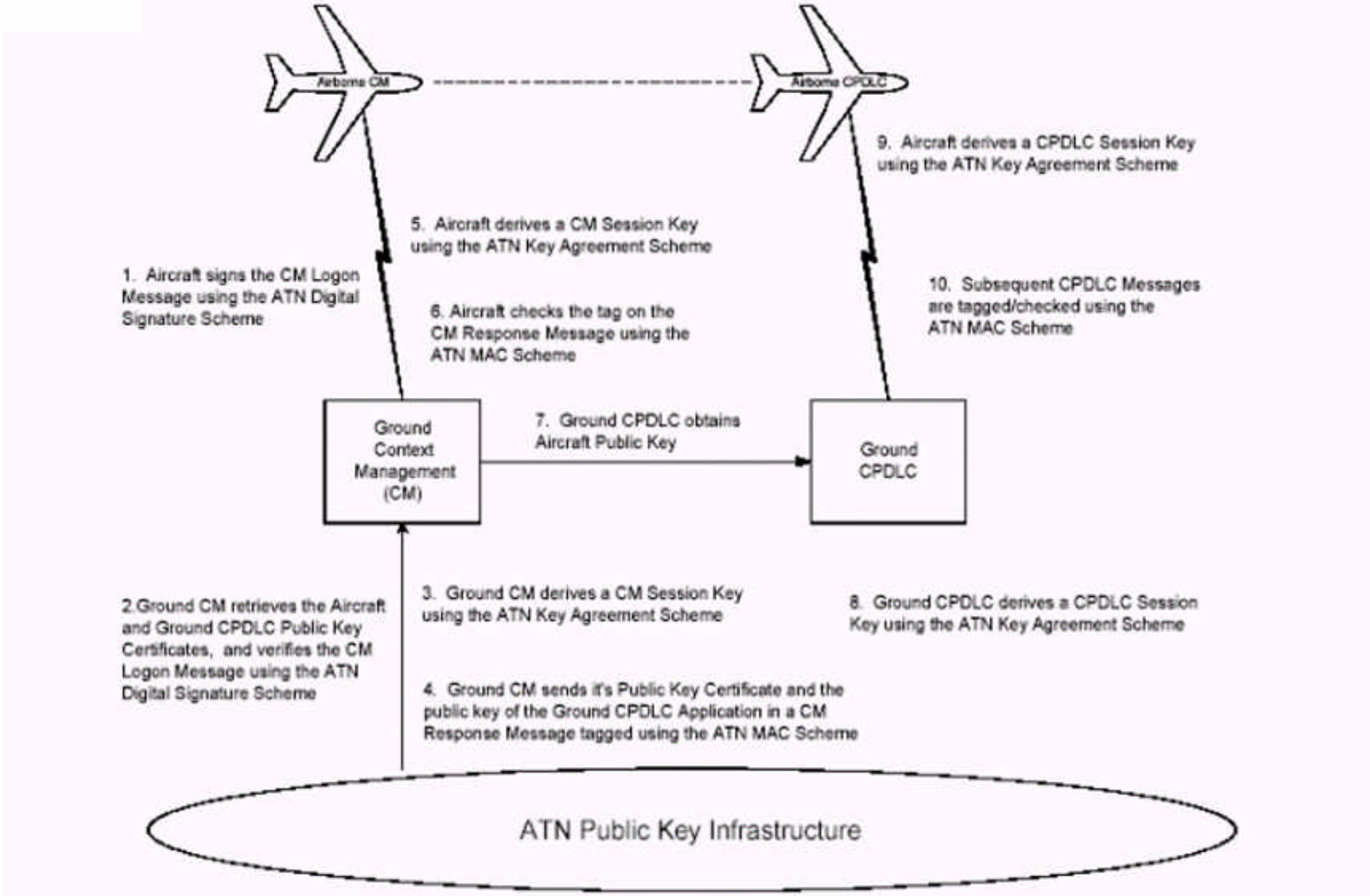
Military Applications

ATN Security Notes

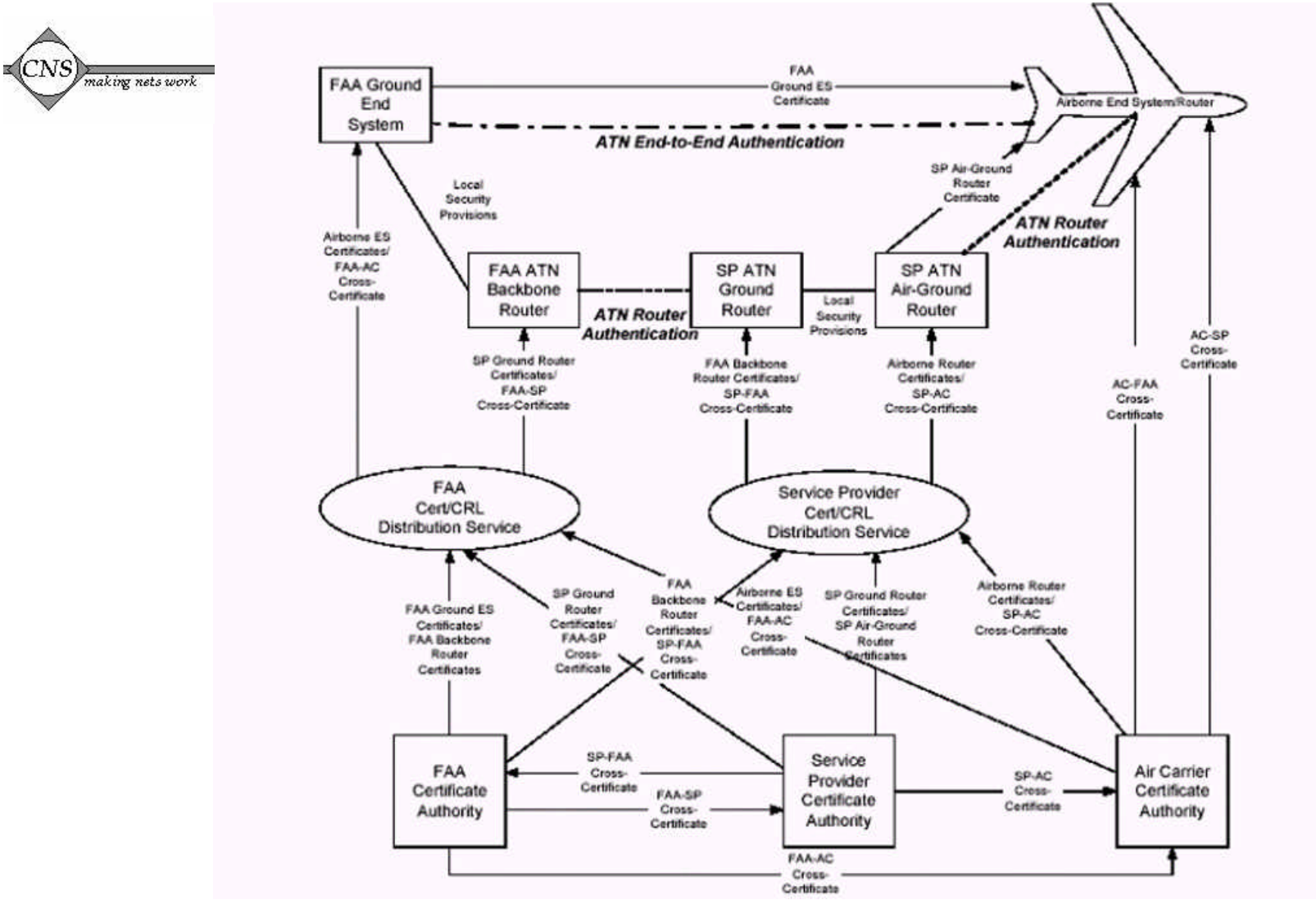
- Encryption
  - Still under development
  - Asymmetric Cryptography (Public/Private Keys)
    - Session Specify Secret Key (variant of Diffie-Hellman)
- Message Authentication
  - HMAC, IETF RFC 2104
  - Hash Function(Secure Hash Algorithm Revision One NIST)
- Authentication
  - Digital Signature (elliptic curve variant of Digital Signature Algorithm)
  - Hash Function
  - Asymmetric Enciphered (private key)
  - Certificate Authority
  - Cross-certificates

Example of Cryptographic Services

Can CPDLC bandwidth handle encryption and AAA?



Example of Certificate Environment



Conclusions

- Security is necessary, albeit often painful
- Key distribution and AAA methods need to be developed that ease the deployment
- We need to be aware of middleware
- Increased security requires increased bandwidth and connectivity
- A mobile networks means different things to different people
  - Mobile user
  - Entire networks in motion
- To much security may result in less security
  - Security bypassed for the sake of performance!